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ABSTRACT

This document is one of six which set forth the mathematics components of the Project SEARCH Articulated Curriculum developed by the Utica (New York) City School District. Each volume deals with a broad area of mathematics and lists objectives related to that area for all grades from K through 12. Each objective listed is described first in general terms and then in terms of specific skills which students should exhibit. This volume concerns geometric concepts, theorems, and methods, including trigonometry and a few topics from the calculus. (SD)

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Articulated Curriculum

Project Search

1975

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FOREWORD

This Articulated Curriculum is being printed and bound in this manner to provide for on-going revision. This also serves as evidence of work completed during Phase III of Project SEARCH.

MATHEMATICS

K - 12

Geometry

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ARTICULATED CURRICULUM

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MRS. ROSE DANELLA and NORMAN I. SIEGEL, both former Board Members deserve special mention for all their efforts on behalf of Project SEARCH.

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MATHEMATICS

GEOMTRY

Definitions

The student will know:

Grade K

The student will:

- the physical shapes of circles, rectangles, squares, and triangles.

- identify objects having circular, rectangular, square and triangular shapes.

Grade 1

- the basic properties of circles, squares, rectangles, and triangles.

- identify circles, squares, rectangles, and triangles according to basic properties, when given pictures.

Grade 2

- the properties of parallel lines.

- be able to recognize and draw parallel lines.

- the concept of infinite lines.

- describe the concept of infinite lines.

- the names of simple geometric figures.

- be able to write geometric names when given geometric figures.

Grade 3

- that a point is a position without length or width usually represented by a dot.

- be able to make a point and draw many lines through it.

- that a line is a series of points connected by a long narrow mark.

- be able to draw a line through a series of points.

- that a line segment is a part of a line with two definite end points.

- name a line segment given a line broken into many lines.

- that a ray is part of a line with one definite end point.

- draw a ray given one end point.

- that an angle is formed by two rays with a common point.

- be able to place a point on paper and draw two rays from this point thus forming an angle.

- the definitions of closed curves, circles, open curves, polygons, triangles, quadrilaterals, rectangles and squares.	- draw an example of closed curve, circle, open curve, polygon, triangle, quadrilateral, rectangle and square.
	- identify each of them.
- the meaning of pentagon, hexagon, perpendiculars, spheres, planes, symmetry and lines of symmetry.	- match geometric figures with definitions.
	Grade 4
- the definitions of prism and cyclinder.	Grade 5
	- recognize and name the shape of a prism and cyclinder.
- the construction of hexagon, equivalent triangle.	- construct a hexagon and equivalent triangle.
- the bisection of a line segment.	- construct the bisection of a line segment.
	Grade 6
- the definitions of trapezoid and its legs, chord, diameter, radius, arc, sector, and segments, and parallelogram.	- describe a trapezoid and its legs, diameter, chord, radius, arc, sector and segments, and parallelogram.
- the symbols for congruency, similarity, equivalency, triangle, circle and angle.	- use the symbols in arithmetic sentences.
Congruency and Similarity	
- the circumference of a circle.	- find circumference of a circle with the formula.
- the area is the measure of the interior of a plane figure.	- find the area of closed plane figures using formulas.

- the volume is the measure of the interior of a solid figure.	- find the volumes of rectangular shapes.
	Grade 7
- the classification of a point.	- describe and recognize a point.
- the classifications of lines.	- describe and recognize a line, line segment ray, interesecting lines, parallel lines, perpendicular lines. Describe and recognize horizontal, vertical and slanted lines.
- the classifications of angles.	- describe and recognize obtuse, acute, right, straight angles according to their sizes. - recognize vertical and adjacent angles.
- the classification of a plane.	- describe and recognize a plane.
- the illustrations for:	- draw and recognize correct symbol for a line $\leftrightarrow$, angle $\angle$, ray $\rightarrow$, segment $--$, parallel $//$, interesecting $\not\times$, perpendicular $\perp$.
- the properties of and classification of geometric figures.	- recognize, draw, identify all regular polygons that have 4 - 10 sides. - will find and recognize the verticals and diagonals of a given polygon.
- the components of a circle.	- describe, recognize parts of a circle center point, radius-diameter-chord.
- the classifications of triangles.	- recognize, describe acute, right, obtuse triangles (classified by their angles). - recognize, describe scalene, isosceles, equalateral triangles (classified by sides).

- the symbols for triangles and quadrilaterals.

- recognize and draw correct symbols for all triangles △ , quadrilaterals
  1) rectangle ▭ 2) square □
  3) parallelogram ▱ 4) rhombus ◇
  5) trapezoid ⏢
  (must instruements: compass, straightedge protractor).

- the construction and measurement of geometric figures.

- given a diameter or radius students will construct a circle.

- to measure to the nearest degree any given angle 60° - 180°.

- by using a compass, protractor, straightedge:
  -construct right, obtuse, acute angles
  -bisect an angle
  -bisect a line segment, constructing a line segment
  -construct congruent angles
  - construct perpendicular lines
  - construct parallel lines.

- that the perimeter of regular polygons is the measure around it.

- be given the dimensions necessary for finding perimeter students will calculate its perimeter.

- that the area of polygons is the measure of its interior

- recognize formula for each polygon and calculate, given its dimensions, the area of that polygon.

rectangle - base-altitude (height) b.a.
parallelogram-base-altitude (height) b.a.
square-base-altitude (height) b.a.
rhombus-base-altitude (height) b.a.
trapezoid $\frac{\text{altitude (base + base)}}{2}$ $\frac{A (b + b')}{2}$

triangles - $\frac{\text{base altitude}}{2}$ $\frac{b.a.}{2}$

- the circumference and area of circle.	- recognize the diameter or radius of a circle will calculate the circumference $\pi \cdot d$ or $2\pi r$ and the area πr^2 of any circle.
	Grade 8
- the meaning of the following geometrical terms: altitude. - Angle: acute, adjacent, bisector, central, complementary, congruent, cosine of, inscribed, obtuse, right, sine of, supplementary, tangent of, vertical - Area: of a circle, parallelogram, rectangle, regular polygons, trapezoid, triangle - Axix - Circle: arcs, area, chord, circumference, circumscribed, diameter, graph, inscribed, radius, secant, sector, tangent, - cone- Construction: bisecting an angle, bisecting a linesegment, circumcircle, congruent triangles, incircle, parallel lines, perpendicular lines, - Cylinder - Deductive reasoning Directed line segments Hypotenuse - Inductive reasoning - Line(s): graph, intersecting, parallel, perpendicular, perpendicular to a plane - Line Segments: congruent. directed - Measure(s): angles, line segments - midpoint- Parallel Lines: alternate interior/exterior angles, corresponding angles, transversal - parallelogram - perimeter - P: - Planes - Points, geometric: betweeness, collinear - Polygonal region - Polygans: area, diagonals, perimeter, Polyhedrons: prism, pyramid - prism, pyramid - Prism; right, surface area, volume - Pyramid: regular, area, volume - Pythagorean therom - Quadrants - Ray - Rectangle _ Rectangular Solid - Rhombus - Right triangle Slope of a line - Sphere: area, circles of, volume - square - supplementary angles - Tangent: acute angle, to a circle, table of values.	- list, recognize and name appropriate symbols of geometry. - recognize and know the meaning of geometric terms.

Trapezoid - Triangle(s): acute, angle, attitude, area, circumcircle, circumscribed, congruent, equalateral, incircle, inscribed isosceles, obtuse, perimeter, right, right isosceles, scalene, similar, 30-60 right - Volume: cone, cylinder, pyramid, rectangular solid, sphere - and the following symbols: = equal to, $<$ less than, $\neq$ not equal, $>$ greater than, $\geq$ greater than or equal, $\leq$ less than or equal, $\overline{AB}$ line segment AB, $\overleftrightarrow{CD}$ line CD, $\overrightarrow{CD}$, ray CD, $\angle ABC$ angle ABC, M $(\overline{AB})$ measure of line segment AB, $\cong$ is congruent to, M $\angle$ EKF measure of angle EKF, $\perp$ is perpendicular to, $\triangle$ ABC, triangle ABC, $\parallel$ parellel to, $\overset{\frown}{GJ}$ minor are GJ, $\overset{\frown}{GHJ}$ major are GHJ.

- the basic properties of congruence as applied to line segments: that line segments having the same measure are congruent ___angles: that angles having the same measure are congruent _____triangles: that if the triangles corresponding angles and corresponding sides are congruant than the triangles are congruent (and vice versa).	- gain an intuitive understanding of congruent line segments, angles and triangles.
- that the classical restrictions on geometric construction are the use of only a straight edge and compass.	- develop means to construct various geometric constructions such as congruent line segments, angles and triangles.
- that in deductive reasoning certain general statements, called assumptions, assumed to be true, provide evidence that other statements, called conclusions, are also true.	- reason from stated definitions and assumptions and deduce conclusions to informed geometric problems.
- the related concepts of the relationships of space as applied to perimeter, area and volume.	- utilize the concepts of sets and subsets, of geometric figures and the formulas for perimeter, area and volume.

- that if the corresponding angles of two triangles are congruent and the measures of the corresponding sides are proportional, then the triangles are similar.	- show how the proportionality of the sides of similar triangles would lead to the solution of practical problems.
- that $c^2 = a^2 = b^2$ is the general form of the Pythagarean Property and that it is applicable to the solution of practical applicati ns problems.	- discover the Pythagorean Property by the determination of the area of three squares each of which has as a side, one side of the right triangle and from this the application to a specific right triangle with, for example sides of 3, 4 and 5 units. - extend the concepts of the Pythagorean Property to include all right triangles and associated practical application problems.
	Grade 9
- the basic geometric shapes	- construct designs using the basic geometric shapes.
- the relationship between the parts of a figure and the whole figure.	- construct an entire figure given the pieces of the figure.
- the formulas for circumference and area of a triangle is 180°, complementary angles are two angles whose sum is 90°, and supplementary angles are two angles whose sum is 180°.	- Find the angle of a triangle given the other two, find the complement of an angle and find the supplement of an angle.
- how to solve algebraic problems relating to geometry.	- solve algebraic equations relating to geometry
- the Pythangorean Theorem and its use in solving right triangle problems	- solve right triangles using Pythagorean Theorem.
- the formulas for circumference and area of a circle, the perimeter and area of a polygon.	- write the formulas for area and circumference of a circle, the perimeter and area of a polygon

COMPUTER MATH

APPLICATIONS

Grade 9 - 12

- that computers are a 20th century technological advancement and have an infinite number of uses in the world.	- list 10 uses of the computer.
- that computers do not always make positive contributions to society.	- make an evaluation of the pros and cons of computers.
- that computers play an important part in his every day life.	- list 10 ways in which computers or their output are used by him.
- that computers cannot solve all problems	- select a real-life problem and explain why there can be no computer solution.
-that computers can be used in subject areas that are now math-science oriented.	- write several programs which find solutions to high school non-Math, non-Science problems.

Grade 10

- the method of writing a formal proof from a verbal statement.	- write a demonstration of a formal proof given a verbal statement.
- the theorems and/or postulates for proving triangles congruent	- prove triangles congruent. Prove line segments and/or angles congruent using congruent triangles.
- the theorems involving similarity.	- prove triangles similar.
- the theorems involving similar right triangles.	- prove corresponding sides of similar triangles are in proportion. Find the length of the hypotenuse, leg, altitude or projection of a leg given values for 2 or 3 of the other parts.
- the basic constructions	- construct a given figure based on given facts.
- the fundamental locus theorems.	- describe the locus of points given a condition or set or set of conditions.

- the basic theorems concerning circles.	- prove arcs, angles chords, and other circle-related figures congruent.
-the theorems and postulates regarding parallelism	- prove lines parallel given a verbal statement involving two lines cut by a transversal.

ADVANCED FOUNDATIONS

Grade 10 - 12

- the classification of angles	- define angle types (acute, right, obtuse, straight and reflex) by their measure.
- the relationships between lines	- identify perpendicular, parallel, coincident and intersecting lines.
- the different types of polygons	- identify the polygon types by the number of sides, measure of angles and length of sides.
- the perimeter of polygons	- calculate perimeters of different polygons
- the area of polygons	- calculate areas of different polygons
- the circles	- calculate circumference and area of a circle
- the basic geometric constructions	- construct angle and line segment bisectors

MATHEMATICS

GEOMETRY

Grade 11

- the definitions of the 6 trigonometric functions: sine, cosine, tangent, cotangent, secant, and cosecant.	- find the values for the six trigonometric functions given a or table of values. b) express an angle in degrees and in radians. c) name the values of the 6 trigonometric functions for angles which are multiples of 45° and 30°.
- the relationship between a trigonometric function and the terms form, amplitude and period.	- graph a trigonometric function (eg. $y = \sin x$) considering its form, amplitude and period

- the definition of an inverse trigonometric function.	- graph an inverse function.
- the rules for expressing a function of an angle greater than 90° in terms of a function of an acute angle.	- express in writing a function of an angle greater than 90° in terms of a function of an acute e.g. $\sin 210^\circ = \sin 30^\circ$.
- the identities of the sine, cosine and tangent functions (sum and difference of 2 angles, double, half-angle identities, and other basic identities).	- derive each of the identities in written form. - prove other identities using the basic ones.
- the law of sines and cosines of triangles i.e. $a^2 = b^2 + c^2 - 2ab \cos c$ & $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$	- solve a triangle for various sides and/or angles given certain sides and/or angles.
- the area formula for the area of a triangle: $A = 1/2\ ab \sin C$.	- find the area of a triangle given 2 sides and an included angle using this formula.
	Grade 12
- the geometric definition of the Conic Section - a) circle c) parabola b) ellipse d) hyperbola	- derive the standard form of the equation of each of the conic sections by using the geometric definition of each. - derive the general form of each equation of each conic section and compare these results with the overall general quadratic equation. From these individual general equations the student will list those characteristics that must serve as unique means of conic section identifications. - show correlation between the above, and from this correlation will prepare and list the raw data that will comprise inputs to a computer, in a computer oriented environment.

- the meaning of vector notation for finding: distances between 2 points, distances between a point and a line, and determining whether 3 points are colleanear or not.	- find the distances between a point and a line, using vector notation.
- the method to find the slopes of vector and the method to write a vector equation..	- find the slope of vector and determine whether or not they are intersecting or non-intersecting vectors.
- the method to prove geometric theories by plane analytical geometry notations and/or vector notations.	- prove a geometric theorem using plane analytical geometry notation or vector notation.
- the solution of triangles by using the law of lines or the law of cosines.	- determine the side of a triangle given two angles and a side of a triangle.
- the method of changing rectangular coordinates to polar coordinates.	- plot a point given its polar coordinates and find the rectangular coordinates of that point.
- the method of changing complex numbers in the form a + b to polar form.	- write a + b form a complex number given its absolute value and amplitude.
- the increment method of finding the first dirivation.	- Find $\frac{\Delta y}{\Delta x} = \lim \frac{(fx - f(\Delta x))}{\Delta X}$
- differentation of polynomials	- find the first and second dirivatives of a fourth degree polynomial.
- the chain rule of differentation	- find $\frac{dy}{dx}$ if $y = s2 + 4s$ and $s=3x$
--the relation between polynomial function and its graph	- show that the function $f(x) = -x^3 - 2x^2 + x - 3$ has at most one real zero.

- the characteristics of specific geometric figures: lines, triangles, parallelograms, regular polygons, trapezoids, cubes, parallelepipeds, cylinders and cones.

- apply the characteristics of specific geometric figures in solving problems.

- the conic figures from their equations.

- identify conic figures from their equations.

- the important points of conic figures i.e. axis of symmetry, center, vertices, foci; directrix; also eccentricity and asymptotes from the equations.

- find axis of symmetry, center, vertics, asymptotes, directrix, foci, eccentricity of conic figures from their equations.

- the application of formulae learned in Math 10, 11, and 12X.

- apply formulae learned in Math 10. 11. and 12X.